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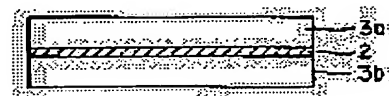
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## (54) POLARIZING PLATE AND LIQUID CRYSTAL DISPLAY DEVICE

## (57)Abstract:

**PROBLEM TO BE SOLVED:** To obtain such a polarizing plate comprising a polarizer and protective films on both surfaces that has excellent productivity and transmitted light hardly shows yellow color by using a specified film for at least one of the protective films.

**SOLUTION:** Protective films 3a, 3b are formed with adhesive layers on both surfaces of a polarizer 2. The protective film is generally adhered to the surface of the polarizer with an adhesive. Further, a hard coating layer may be formed on the protective film. The protective film used is a polyethylene-2,6-naphthalate (PEN) film. A PEN film and a triacetylcellulose (TAC) film containing a UV absorbent which is conventionally used as a protective film do not transmit UV rays of about  $<380\text{m}\mu$  wavelength. However, if even a small absorption is present in the vicinity of  $400\text{m}\mu$ , the light transmitted through a display device shows a yellow color. A PEN film has no absorption but a TAC film has a little absorption.



CLAIMS

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## [Claim(s)]

[Claim 1] The polarizing plate characterized by at least one side of this protective coat being polyethylene -2 and 6-naphthalate film in the polarizing plate with which it comes to prepare a protective coat in a polarizer and its both sides.

[Claim 2] The liquid crystal display with which this protective coat is characterized by being polyethylene -2 and 6-naphthalate film in the liquid crystal display which consists of a liquid crystal cell which consists of liquid crystal enclosed between the transparence substrates of a pair with which the transparent electrode was prepared, and those transparence substrates, and a polarizing plate of a pair with which it comes to prepare a protective coat in the polarizer prepared in the both sides of this liquid crystal cell, and its both sides.

[Claim 3] The liquid crystal display according to claim 2 whose protective coats of the side which does not counter the liquid crystal cell of this polarizing plate are polyethylene -2 and 6-naphthalate film.

DETAILED DESCRIPTION

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## [Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the liquid crystal display which has the polarizing plate and polarizing plate of a liquid crystal display which are used for a personal computer, a word processor, television, etc.

[0002]

[Description of the Prior Art] It is being used more often under a harsh environment by the liquid crystal display with which the personal computer, the word processor, the clock, the calculator, etc. were used like the liquid crystal display for a touch panel, an optical shutter, or automobile loading.

[0003] Generally the cellulose triacetate (TAC) which the polarizing plate used for the above-mentioned liquid crystal display has the configuration which the protective coat pasted up on a polarizer and its both sides, and the thing which made iodine and/or dichromatic dye stick to the polyvinyl alcohol (PVA) by which uniaxial orientation was carried out as a polarizer is generally used, and has good light transmission nature and a small birefringence as a protective coat is used.

[0004] Although the above-mentioned cellulose triacetate film has the property which was excellent in light transmission nature, an optical non-stacking tendency, etc., since there is no property which absorbs ultraviolet rays, in order to prevent degradation by the ultraviolet rays of the liquid crystal of a liquid crystal display, generally adding an ultraviolet ray absorbent in the cellulose triacetate film which is the protective coat of the polarizing plate prepared in the outside of a liquid crystal display is performed. Namely, the film of cellulose triacetate can cast the dope which dissolved the cellulose triacetate of the 60 - 62% of the amounts of joint acetic acids (whenever [ acetylation ]) in the partially aromatic solvent of a methylene chloride and a methanol with the plasticizer on the drum which rotates continuously, or the band (base material) which moves, and can obtain it by the solution producing-film method which consists of subsequently evaporating a solvent. And the dispersion liquid which distributed the ultraviolet ray absorbent currently used from the former for light-fast (ultraviolet ray degradation is prevented) improvement to the mixed solution of a solvent or a solvent, and cellulose triacetate, and were obtained were mixed with the above-mentioned dope, and the film of cellulose triacetate was produced by casting this mixed liquor and drying. This had given lightfastness with the ultraviolet ray absorbent.

[0005]

[Problem(s) to be Solved by the Invention] In order to use a cellulose triacetate film as a protective coat for polarizing plates, it is necessary to add an ultraviolet ray absorbent and to produce a film in a cellulose triacetate dope, as mentioned above, and a process is complicated. Moreover, the film which is obtained according to examination of this invention person, and the problem that it absorbs considerably to the light of the visible region near the wavelength of 400nm and a film wears the yellow taste in many cases became clear.

[0006] Therefore, this invention is excellent in productivity and aims at offering the polarizing plate with which the transmitted light hardly wears the yellow taste. Moreover, this invention is excellent in productivity and aims at offering the liquid crystal display with which the transmitted light cannot wear the yellow taste easily.

[0007]

[Means for Solving the Problem] In the polarizing plate with which it comes to prepare a protective coat in a polarizer and its both sides, the polarizing plate characterized by at least one side of this protective coat being polyethylene -2 and 6-naphthalate film can attain the above-mentioned purpose.

[0008] The desirable mode of the polarizing plate of above-mentioned this invention is as follows.

1) The permeability of light with a wavelength [ of this protective coat ] of 400nm is 70% or more (preferably 80% or more).

2) This polyethylene -2 and 6-naphthalate film contain the silica of the primary particle to which it has the specific surface area of 5-45m<sup>2</sup> / g, the pore volume of 0.001 - 0.1 ml/g, and the mean particle

diameter of 0.1–5.0 micrometers, and each is a polyhedron and \*\*\*\*\* the projection of an acute angle at least.

3) This polyethylene -2 and 6-naphthalate film contain the silica of the above 3 at 0.001 – 0.1% of the weight of a rate to the weight of this polymer.

4) Polyethylene -2 and 6-naphthalate film contain the grinding object of a natural quartz.

5) The thickness of polyethylene -2 and 6-naphthalate film is 20–300 micrometers (preferably 50–100 micrometers).

[0009] Moreover, in the liquid crystal display which consists of a liquid crystal cell which consists of liquid crystal enclosed between the transparence substrates of a pair with which the transparent electrode was prepared, and those transparence substrates, and a polarizing plate of a pair with which it comes to prepare a protective coat in the polarizer prepared in the both sides of this liquid crystal cell, and its both sides, the liquid crystal display with which this protective coat is characterized by being polyethylene -2 and 6-naphthalate film can also attain the above-mentioned purpose.

[0010] The desirable mode of the liquid crystal display of above-mentioned this invention is as follows.

1) The protective coats of the side which does not counter the liquid crystal cell of a polarizing plate are polyethylene -2 and 6-naphthalate film.

[0011] The polarizing plate of [description with detailed invention] this invention has the basic configuration with which the protective coat was prepared in the front face of the both sides of a polarizer and this polarizer. The cross section of the fundamental configuration of the polarizing plate of this invention is typically shown in drawing 1.

[0012] The polarizing plate with which protective coats 3a and 3b were formed in the front face of both polarizers 2 through the glue line is shown in drawing 1. As for a protective coat, it is common to paste a polarizer front face with adhesives (binder). On a protective coat, a rebound ace court layer may be formed further. The above-mentioned protective coats are polyethylene -2 and 6-naphthalate film in this invention. Since the protective coat located between a polarizer and a liquid crystal cell needs to have the value of a low retardation (Re) generally when the above-mentioned polarizing plate is built into a liquid crystal display, the film with which low Re values, such as triacetyl cellulose, are easy to be acquired may be used. The polyethylene -2 of a low Re value and 6-naphthalate film are obtained by creating a film for example, in the state of no extending. Re value is expressed with the product of the direction of a lagging axis of a film, the difference (deltan) of the refractive index of phase leading shaft orientations, and the thickness (d) of a film.

[0013] The above-mentioned polarizing plate shows the example of a configuration of a liquid crystal display prepared in the both sides of a liquid crystal cell to drawing 2. In the liquid crystal display shown in drawing 2, polarizing plates 11a and 11b are stuck and formed in the both sides of the liquid crystal display 15 by which liquid crystal was pinched with the glass plate which has an electrode. Polarizing plate 11a consisted of protective coats 23a and 23b stuck on a polarizer 22 and its both sides, and protective coat 23b is in contact with the glass plate front face of a liquid crystal cell 5 (usually stuck by adhesives). Polarizing plate 11b consists of protective coats 13a and 13b stuck on a polarizer 22 and its both sides similarly. Protective coats are polyethylene -2 and 6-naphthalate film. However, since the protective coats 13b and 23b located between a polarizer and a liquid crystal cell need to have the value of a low retardation (Re) generally as mentioned above, the film with which low Re values, such as triacetyl cellulose, are easy to be acquired may be used for them. An acid-resisting layer may be prepared on a polarizing plate.

[0014] The permeability curve in the ultraviolet-rays field of polyethylene -2, 6-naphthalate film (80 micrometers in thickness), and the ultraviolet ray absorbent content triacetyl cellulose (TAC) film (120 micrometers in thickness) currently used as the above-mentioned protective coat from the former is shown in drawing 3. The TAC film and PEN film is also intercepting mostly and shows that all of an ultraviolet absorption function are large without penetrating the ultraviolet rays of the short wavelength below near 380mmicro, so that clearly from drawing 3. 380–400 which hardly affect a light-fast fall — there is a problem that the light which penetrated the display m micro when absorption was near 400mmicro especially wears the yellow taste. [ however, ] In the case of a PEN film, there is almost no

absorption near 400mmicro, but in the case of the TAC film containing an ultraviolet ray absorbent, a little absorption is near 400mmicro, and the light which penetrated the display will wear the yellow taste. Even if it changes the class of ultraviolet ray absorbent used for a TAC film, there is same inclination. Therefore, using polyethylene -2 and 6-naphthalate film as a protective coat (protective coat of the side in contact with especially an outside and atmospheric air) of a polarizing plate brings about an advantage that the yellow taste is not worn on the above-mentioned transmitted light with the outstanding productivity.

[0015] A well-known thing can be used for the polarizer used for the polarizing plate of this invention. For example, the polarization film which carried out adsorption orientation of iodine and/or the dichromatic dye to hydrophilic high polymer films, such as a polyvinyl alcohol system film, a partial formal-ized polyvinyl alcohol system film, and a saponification film of an ethylene-vinylacetate copolymer; the polarization film to which demineralization acid treatment of polarization film; and the polyvinyl chloride film to which dehydration processing of the polyvinyl alcohol system film was carried out, and orientation of the polyene was carried out was carried out, and orientation of the polyene was carried out can be mentioned.

[0016] The polyethylene -2 used for the protective coat of this invention and 6-naphthalate are polymers which a main configuration monomer becomes from ethylene -2 and 6-naphthalate. In this case, the configuration unit by other components may be included by copolymerization in not more than 10 mol %. As a bifunctional carboxylic-acid component which can serve as a copolymerization unit, polyfunctional carboxylic acids or those alkyl ester, such as aliphatic series dicarboxylic acid, such as aromatic series dicarboxylic acid, such as isophthalic acid, a terephthalic acid, and 5-sodium sulfoisophtharate, 1, 4-cyclohexane dicarboxylic acid, an adipic acid, and a sebacic acid, those alkyl ester and trimellitic acid, and pyromellitic acid, etc. can be mentioned, for example. On the other hand, as glycol components other than ethylene glycol which can serve as a copolymerization unit similarly, a diethylene glycol, butanediol, the polyalkylene glycol 1 of molecular weight 150-20000, 4-cyclohexane dimethanol, the ethyleneoxide addition product of bisphenol A, etc. can be mentioned.

[0017] Moreover, the esterification reaction catalyst used at the time of manufacture of polyethylene -2 and 6-naphthalate, an ester exchange reaction catalyst, and a polycondensation reaction catalyst can use suitably the titanium compound known from the former, a manganese compound, a zinc compound, an antimony compound, a magnesium compound, a lime compound, a germanium compound, etc. Moreover, according to the purpose, other metallic compounds, a nitrogen-containing basicity compound, an antioxidant, an antistatic agent, a fluorescent brightener, a color, etc. may be used. Moreover, the manufacture approach of polyester can be performed by the usual approach learned from the former. That is, any of a batch process, an anti-batch process, and continuous system are sufficient, and an ester exchange reaction method or a direct esterification reaction method may be used.

[0018] Although the film or non-oriented film by which biaxial stretching was carried out is sufficient as the polyethylene -2 of this invention, and 6-naphthalate film when using it as the liquid crystal cell of a polarizer, and a protective coat of the opposite side (outside), its biaxial stretching from which uniform thickness is obtained is desirable. Moreover, when using it as a protective coat by the side of the liquid crystal cell of a polarizer, it is desirable that it is a non-oriented film. An approach well-known as the manufacture approach of a biaxially oriented film can be used. for example, after drying polyethylene -2 and 6-naphthalate beforehand and carrying out melting push appearance to the shape of a sheet at 275 degrees C - 320 degrees C, cooling solidification is carried out at 45-100 degrees C, and a non-fixed form sheet is produced. Subsequently, after extending subsequently to [ 2 to 5 times ] at the temperature of 80 degrees C - 190 degrees C in a lengthwise direction (the direction of a long picture) at a longitudinal direction (cross direction), respectively, biaxial-stretching polyethylene -2 and 6-naphthalate film can be obtained by heat-treating at 165-290 degrees C at it. Furthermore, annealing treatment may be performed to the obtained film at the temperature below the glass transition temperature of polyethylene -2 and 6-naphthalate. moreover, after carrying out melting push appearance of the polyethylene -2 dried beforehand and the 6-naphthalate on a cooling roller at 275

degrees C – 320 degrees C as the manufacture approach of a non-oriented film at the shape of a sheet, for example, it is created through a calendering roll. It can create with the equipment generally called a sheet making machine. Generally the 3–5 above-mentioned calendering rolls are arranged continuously. The thickness of a film has common 20–300 micrometers, its 30–200 micrometers are desirable, and its 50–100 micrometers are especially desirable.

[0019] As for the polyethylene -2 of this invention, and 6-naphthalate film, it is desirable as a slipping nature grant agent that the particle of organic compounds, such as crosslinked polymers, such as inorganic compounds, such as talc, a silica, an aluminum oxide, a calcium carbonate, and carbon, and acrylic resin over which the bridge was constructed, benzoguanamine resin, is included. In these, a silica is desirable and the silica of the primary particle to which it has the mean particle diameter which is the specific surface area of 5–45m<sup>2</sup> / g, the pore volume of 0.001 – 0.1 ml/g, and 0.1–5.0 micrometers, and each is a polyhedron and \*\*\*\*\* the projection of an acute angle at least especially is desirable. As for such a particle, it is desirable to contain at 0.001 – 0.1% of the weight of a rate to the weight of a polymer.

[0020] Moreover, in this invention, the specific surface area of the silica of the specific primary particle which has the projection of the above-mentioned acute angle is 5–45m<sup>2</sup> / g, and its 10–30m<sup>2</sup> / g are especially desirable. In order that a silica particle may condense mutually the silica to which specific surface area exceeds 45m<sup>2</sup> / g and it may tend to form an aggregated particle and the high order big and rough particle beyond it, the slipping nature of the film obtained falls. The void produced on the other hand when biaxial stretching is carried out, since, as for the silica of under 5m<sup>2</sup> / g, specific surface area becomes [ compatibility with a polymer ] low becomes large, and the transparency of a film falls. Furthermore, pore volume is 0.001 – 0.1 ml/g, and its range of 0.01 – 0.06 ml/g is [ the silica of the specific primary particle which has the projection of the above-mentioned acute angle ] desirable. In order that a silica particle may condense mutually the silica to which pore volume exceeds 0.1 ml/g and it may tend to form an aggregated particle and the high order big and rough particle beyond it, the slipping nature of the film obtained falls. Moreover, quality may not be stabilized. The void produced on the other hand when biaxial stretching is carried out, since, as for the silica of less than 0.001 ml/g, pore volume becomes [ compatibility with a polymer ] low becomes large, and the transparency of a film falls.

[0021] It is 0.1–5.0 micrometers, the mean particle diameter of the silica of the specific primary particle which has the projection of the above-mentioned acute angle has desirable 0.1–1.0 micrometers, its further 0.1–0.8 micrometers are desirable, and its 0.1–0.55 micrometers are especially desirable further again. The film with which mean particle diameter contained such a silica since a less than 0.1–micrometer silica had the small grant effectiveness of slipping nature does not have enough slipping nature, or when extent which obtains sufficient slipping nature is made to contain a silica, the transparency of a film falls. Moreover, although the effectiveness is large, if a particle with such big particle diameter is used, in a biaxially oriented film, it will become easy to produce a big void around a particle, and, as for the silica to which mean particle diameter exceeds 5.0 micrometers, Hayes will serve as a low high film of transparency from a viewpoint of slipping nature grant as a result. Moreover, it becomes a serious defect, when a silica with such large particle diameter condenses and it exists in a film.

[0022] The silica of the above-mentioned primary particle is obtained by crushing and generally, grinding a natural quartz on conditions which have the projection of an acute angle. Furthermore, the silica of a primary particle is the grinding object of a natural quartz, and that [ its ] by which the chamfering proces is not made is desirable. If a chamfering proces is carried out, the projection of an acute angle will decrease. A classification sorts out the thing of the above-mentioned specific particle, and the quartz by which grinding was carried out [ above-mentioned ] is obtained. As for the silica of the primary particle of this invention, what was obtained considering the high grade quartz as a raw material also in the natural quartz is desirable. Therefore, the purity of the silicon dioxide of the silica obtained also has the desirable thing of a high grade, and more than its 99.5% (weight) is especially desirable, and more than its 99.8% (weight) is desirable. Moreover, in order that the silica of the above-mentioned primary particle may improve the dispersibility of a particle, and the compatibility to polyethylene -2 and 6–

naphthalate, surface treatment processings, such as coupling agent processing and graft processing, may be made. Furthermore, the silica by which particle size distribution was narrowed by the classification etc. can also be used preferably.

[0023] Although the silica which has the above-mentioned property can also add polyethylene -2 and 6-naphthalate directly at the time of melting extrusion, especially in order to obtain a film with little Hayes with sufficient smoothness without condensation coarse grain, it is desirable to carry out combination addition in a phase until it starts a polycondensation reaction among the production process of polyethylene -2 and 6-naphthalate. A silica is added with 0.001 - 0.1% of the weight of an addition to polyethylene -2 and 6-naphthalate in that case. May fabricate on a film the polyethylene -2 and 6-naphthalate which were obtained as mentioned above as it is, and The polyethylene -2 of 0.1 - 20% of the weight of an addition and 6-naphthalate are manufactured. Or this polyethylene -2 and 6-naphthalate constituent, The polyethylene -2 which does not contain a silica, and the so-called masterbatch format which mixes 6-naphthalate and is used as a film may be adopted and fabricated. In case a silica is added in the production process of polyethylene -2 and 6-naphthalate also in which approach, it is desirable to make ethylene glycol distribute a silica enough beforehand, to make it a uniform slurry regime, and to add.

[0024]

[Example] Hereafter, this invention is not limited by this although an example explains this invention still more concretely. In addition, the "section" in an example shall mean the weight section.

[0025] [The example 1 of manufacture]

(Manufacture of polyethylene -2 and 6-naphthalate) After supplying 2, the 6-naphthalene dicarboxylic acid dimethyl 100 section and the ethylene glycol 58.4 section, the manganese acetate 4 hydrate 0.03 section, and the antimony-trioxide 0.025 section to the esterification reaction vessel equipped with the agitator, the heat carrier jacket, and the fractionating tower, contents were heated to 200 degrees C, stirring. Removing the methanol generated by the reaction from a fractionating tower, whenever [ system internal temperature ] was raised at a rate of 20 degrees C in 1 hour, and was made into 250 degrees C. After checking that the byproduction of a methanol had been completed, the resultant was moved to the polycondensation tub equipped with the double helical aerofoil, the heat carrier jacket, and the vacuum pump as an agitator, and what dissolved the phosphoric-acid 0.021 section in the ethylene glycol 0.5 section was added. It stirred for 5 minutes after the completion of addition, subsequently to 0.15 torrs the inside of a system was decompressed gradually, the polycondensation reaction was performed at 280 degrees C - 300 degrees C for about 2 hours, and polyethylene -2 and 6-naphthalate were obtained.

[0026] [The example 2 of manufacture]

(Manufacture of silica content polyethylene -2 and 6-naphthalate) After supplying 2, the 6-naphthalene dicarboxylic acid dimethyl 100 section and the ethylene glycol 58.4 section, the manganese acetate 4 hydrate 0.03 section, and the antimony-trioxide 0.025 section to the esterification reaction vessel equipped with the agitator, the heat carrier jacket, and the fractionating tower, contents were heated to 200 degrees C, stirring. Removing the methanol generated by the reaction from a fractionating tower, whenever [ system internal temperature ] was raised at a rate of 20 degrees C in 1 hour, and was made into 250 degrees C. After checking that the byproduction of a methanol has been completed, as an agitator a resultant A double helical aerofoil, the silica (specific-surface-area: — 17m<sup>2</sup> / g —) of the primary particle which moves to the polycondensation tub equipped with the heat carrier jacket and the vacuum pump, and has the projection of an acute angle Pore volume: 20% ethylene glycol slurry containing 0.03 ml/g, and the mean-particle-diameter:0.5-micrometer 1.2 sections was added, and what dissolved the phosphoric-acid 0.021 section in the ethylene glycol 0.5 section further was added. It stirred for 10 minutes after the completion of addition, subsequently to reduced pressure the inside of a system was carried out gradually, the polycondensation reaction was performed at 280 degrees C - 300 degrees C for about 2 hours, and silica content polyethylene -2 and 6-naphthalate were obtained. In addition, the include angle (thing of inner min of the interior angle of the projection drawing of a silica particle) of a projection of the silica of the primary particle which has the projection of an acute angle

had all of ten particles in the range which is 60 – 25 degrees as a result of the observation of the electron microscope.

[0027] After fully mixing the polyethylene terephthalate 98 section which does not contain the silica obtained in the example 1 of [example 1] manufacture, and the silica content polyethylene terephthalate 2 section obtained in the example 2 of manufacture and drying at 160 degrees C for 8 hours, melting extrusion was performed at 295 degrees C, and the sheet was obtained. After extending the obtained sheet 3.5 times to the lengthwise direction at 135 degrees C and extending 4.5 times at 140 degrees C subsequently to a longitudinal direction, heat setting was carried out at 240 degrees C, and the biaxially oriented film with a thickness of 80 micrometers was produced.

[0028] When the permeability in the wavelength of 300–500nm of the film obtained above was measured, the ultraviolet rays of the short wavelength below near 380nm were intercepted completely, and were large, and the permeability near 400nm was high, and it turned out that the transmitted light is what does not wear the yellow taste. [ of the ultraviolet absorption function ] It was used for one protective coat of the polarizing plate which showed this film to said drawing 1 , the ultraviolet ray absorbent content TAC film was used for another protective coat, and the polarizing plate was created. Furthermore, as the TAC film and the substrate of a liquid crystal cell contacted the both sides of a liquid crystal cell, they stuck two obtained polarizing plates on them, and the liquid crystal display shown in drawing 2 was created.

[0029]

[Effect of the Invention] Polyethylene –2 and 6–naphthalate film are being used for the polarizing plate of this invention as a protective coat of a polarizer. Since ultraviolet rays are absorbed to itself, even if the film which made the conventional TAC film contain an ultraviolet ray absorbent is not used for polyethylene –2 and 6–naphthalate, they can intercept ultraviolet rays, and even if it uses it for a long period of time, they do not almost have degrading the property of a polarizer. 380–400 which hardly affect a light–fast fall — nm, since there is almost no absorption near 400nm especially, the light which penetrated the display at the time of using for a liquid crystal display does not wear the yellow taste [ moreover, ] Therefore, the transmitted light which does not wear the yellow taste with the outstanding productivity can be obtained by using polyethylene –2 and 6–naphthalate film as a protective coat (protective coat of the side in contact with especially the outside of a liquid crystal display and atmospheric air) of a polarizing plate.



## DESCRIPTION OF DRAWINGS

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### [Brief Description of the Drawings]

[Drawing 1] It is the sectional view of the example of a typical configuration of the polarizing plate of this invention.

[Drawing 2] The above-mentioned polarizing plate of this invention is the sectional view of the example of a typical configuration of a liquid crystal display prepared in the both sides of a liquid crystal cell.

[Drawing 3] It is a permeability curve in the ultraviolet-rays field of polyethylene -2, 6-naphthalate (PEN) film, and an ultraviolet ray absorbent content triacetyl cellulose (TAC) film.

### [Description of Notations]

11a, 11b Polarizing plate

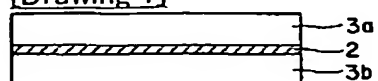
2, 12, 22 Polarizer

3a, 3b, 13a, 13b, 23a, 23b Protective coat

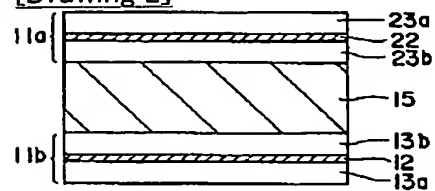
15 Liquid Crystal Cell

## DRAWINGS

[Drawing 1]



[Drawing 2]



[Drawing 3]

